



# *Geothermal Strategic Value Analysis*

*IEPR Workshop*

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*Elaine Sison-Lebrilla  
PIER Program-Renewables*



# *SVA Geothermal Results*



*The results without transmission costs and assuming a PTC  
are the following:*

- ◆ *2692 MW by 2010, 2773 MW by 2017 (combined cycle comparison)*
- ◆ *1808 MW by 2010, 1941 MW by 2017 (E3 comparison)*
- ◆ *0 MW by 2010, 1865 MW by 2017 (Wholesale electricity price comparison)*
- ◆ *1504 MW by 2010, 1798 MW by 2017 (MPR comparison)*



# *SVA Geothermal Results*



*The results with transmission costs and assuming a PTC  
are the following:*

- ◆ *2487 MW by 2010, 2638 MW by 2017 (combined cycle comparison)*
- ◆ *1485 MW by 2010, 1782 MW by 2017 (E3 comparison)*
- ◆ *0 MW by 2010, 1725 MW by 2017 (Wholesale electricity price comparison)*
- ◆ *1485 MW by 2010, 1513 MW by 2017 (MPR comparison)*



# *SVA Geothermal Approach*



- ◆ *Identification and Qualification of Resource*
- ◆ *Calculation of the Cost of Geothermal Electricity Generation*
- ◆ *Addition of New Geothermal Resource to the Grid*



# *Cost of Geothermal Electricity Generation*



- ◆ *Economic Cost Model*
- ◆ *Levelized Cost of Electricity for Each Resource Area*
  - *Calculated with and without PTC*
  - *Calculated with and without Transmission cost*

*Base Cases for Dry Steam, Flash and Binary technologies*



# *Economic Model*



- ◆ ***Methodology: Revenue Requirement Approach***

*The model calculates the leveled cost of electricity (LCOE) in current dollar and constant dollar*

*The analysis considers return on investment, recovery of capital, expenses (O&M Costs), and taxes over the economic life of the project.*

*Calculates LCOE for all geothermal resource areas*



# *Economic Model*



## ◆ *General Assumptions:*

- *Economic life: 20 years for all types of geothermal technologies (dry, steam, flash, binary)*
- *Annual decrease in well productivity = 4%*
- *Royalty rate: 4% of revenue*
- *Federal tax rate = 34%*
- *State tax rate = 6.65%*
- *Production tax credit = \$0.018/kWh*
- *Investment tax credit = 10%*
- *Property tax rate = 1%*
- *Debt ratio = 67%    Equity Ratio = 33%*
- *Interest rate on debt = 8.4%*
- *Cost of equity = 16%*
- *ACRS depreciation (5 yr property) & 30% additional depreciation*



# *Projecting Geothermal Performance and Costs*



- ◆ *Performance projections based on:*
  - *Technology development trends*
    - ✓ *GeothermEx, EPRI & Navigant information*
  - *Assumes moderate development of geothermal technologies*
  
- ◆ *Cost projections based on:*
  - *GeothermEx/PIER – Geothermal Resource Assessment*
  - *Cost reduction trends*
  - *Technology development trends*
    - ✓ *GeothermEx, EPRI & Navigant information*
  - *Calculated LCOE from 2005 to 2017*



# *Dry Steam Capital & O&M Costs*

## *Assumptions*



Technology	Dry Stream		
Year	2005	2010	2017
<b>Installed Capital Costs (\$/kW)</b>			
Exploration Costs			
Confirmation Costs	765	743	720
Site Development Costs	2960	2874	2787
<b>Total Capital Cost</b>	<b>3,725</b>	3,617	3,507
<b>Operation and Maintenance Costs (\$/kW-yr)</b>			
Field, General O&M & Rework	27.8	25.0	22.3
Makeup Wells	10.5	9.4	8.4
Relocate Injection Wells	2.3	2.1	1.9
Power Plant O&M	42.0	37.9	33.7
<b>Total Operating Costs</b>	<b>83</b>	<b>74</b>	<b>66</b>
Capacity Factors (%)	95	95	95



# *Flash Steam*

## *Capital & O&M Costs Assumptions*



Technology	Flash			
Year	2005			
Geothermal Resource Area	Potential Dvlpmnt (MW)	Capital Cost (\$/kW)	O&M Cost (\$/kW-yr)	Capacity Factor (%)
Calistoga	25	3,403	83	90
Brawley (North)	135	2,638	83	90
Brawley (East)	129	4,195	83	90
Brawley (South)	62	4,606	83	90
Coso	55	3,405	83	90
Lake City / Surprise Valley	37	3,146	83	90
Medicine Lake (Fourmile Hill)	36	2,674	83	90
Medicine Lake (Telephone Flat)	175	2,275	83	90
Niland	76	3,249	83	90
Randsburg	48	2,615	83	90
Salton Sea (Low)	1400	2,250	83	90
Salton Sea (High)	1400	4,500	83	90
Sulphur Bank	43	2,347	83	90



# ***Binary Capital & O&M Costs Assumptions***



Technology	Binary			
Year	2005			
Geothermal Resource Area	Potential Dvlpmnt (MW)	Capital Cost (\$/kW)	O&M Cost (\$/kW-yr)	Capacity Factor (%)
Long Valley - M-P Leases	71	2,034	72	93
Honey Lake	1.9	2,684	72	93
Dunes	11	4,085	72	93
East Mesa	74.8	5,141	72	93
Glamis	6.4	4,953	72	93
Heber	42	2,706	72	93
Mount Signal	19	2,746	72	93
Sespe Hot Springs	5.3	4,112	72	93
Superstition Mountain	9.5	3,211	72	93



# *Dry Steam - LCOE (No Transmission)*



Technology	Dry Steam							
	Ptl Dvlpt (MW)	Cap Cost	LCOE (\$/kWh) 2004 Current \$					
Year			2005	2005		2010		2017
Geothermal Resource Area		(\$/kW)	PTC	No PTC	PTC	No PTC	PTC	No PTC
Geysers	400	3,725	0.085 4	0.0965	0.0814	0.0925	0.0774	0.0885



# *Dual Flash - LCOE (No Transmission)*

Technology	Flash								
	Potni Dvlpt (MW)	Cap Cost	LCOE (\$/kWh) 2004 Current\$						
Year			2005		2005		2010		
(\$/kW)		PTC	No PTC	PTC	No PTC	PTC	No PTC		
Calistoga	25	3,403	0.0836	0.0948	0.0786	0.0897	0.0728	0.0839	
Brawley (North)	135	2,638	0.0669	0.0780	0.0613	0.0724	0.0551	0.0662	
Brawley (East)	129	4,195	0.1009	0.1121	0.0932	0.1043	0.0847	0.0958	
Brawley (South)	62	4,606	0.1099	0.1210	0.1017	0.1128	0.0925	0.1036	
Brawley (Total)	326	3,813	0.0926	0.1037	0.0854	0.0965	0.0774	0.0885	
Coso	55	3,405	0.0837	0.0948	0.0770	0.0881	0.0697	0.0808	
Lake City / Surprise Valley	37	3,146	0.0780	0.0891	0.0717	0.0828	0.0648	0.0759	
Medicine Lake (Fourmile Hill)	36	2,674	0.0677	0.0788	0.0621	0.0732	0.0558	0.0669	
Medicine Lake (Telephone Flat)	175	2,275	0.0590	0.0701	0.0539	0.0650	0.03048 2	0.593	
Niland	76	3,249	0.0803	0.0914	0.0738	0.0850	0.0667	0.0778	
Randsburg	48	0.0664	0.0775	0.0775	0.0608	0.0720	0.0547	0.0658	
Salton Sea (Low)	1400	0.0585	0.0696	0.0696	0.0534	0.0645	0.0478	0.0589	
Salton Sea (High)	1400	0.1076	0.1187	0.1187	0.0995	0.1106	0.0904	0.1016	
Sulphur Bank	43	0.0606	0.0717	0.0717	0.0554	0.0665	0.0496	0.0607	



# *Binary - LCOE (No Transmission)*



Technology	Binary							
	Potnl Dvlpt (MW)	Cap Cost	LCOE (\$/kWh) 2004 Current\$					
Year		2005	2005		2010		2017	
Geothermal Resource Area		(\$/kW)	PTC	No PTC	PTC	No PTC	PTC	No PTC
Long Valley - M-P Leases	71	2,034	0.0494	0.0605	0.0443	0.0554	0.0400	0.0511
Honey Lake	1.9	2,684	0.0632	0.0743	0.0549	0.0660	0.0449	0.0560
Dunes	11	4,085	0.0928	0.1039	0.0812	0.0924	0.0670	0.0781
East Mesa	74.8	5,141	0.1151	0.1262	0.1011	0.1122	0.0836	0.0947
Glamis	6.4	4,953	0.1111	0.1222	0.0976	0.1087	0.0807	0.0918
Heber	42	2,706	0.0636	0.0747	0.0553	0.0664	0.0453	0.0564
Mount Signal	19	2,746	0.0645	0.0756	0.0560	0.0671	0.0459	0.0570
Sespe Hot Springs	5.3	4,112	0.0936	0.1045	0.0818	0.0929	0.0674	0.078
Superstition Mountain	9.5	3,211	0.0743	0.0854	0.0648	0.0759	0.0532	0.0643



# *Transmission Cost*



Geothermal Resource Area	Ptl Dvlpt (MW)	Trans Cost (\$x1000)
<b>Dry Steam</b>		
Geyser	400	4,000
<b>Binary</b>		
Long Valley - M-P Leases	71	33,375
Honey Lake	1.9	4,000
Dunes	11	4,000
East Mesa	74.8	4,000
Glamis	6.4	16,000
Heber	42	4,000
Mount Signal	19	8,000
Sespe Hot Springs	5.3	4,028
Superstition Mountain	9.5	1,875

Geothermal Resource Area	Ptl Dvlpt (MW)	Trans Cost (\$x1000)
<b>Flash</b>		
Calistoga	25	3,750
Brawley (Total)	326	94,500
Coso	55	3,750
Lake City / Surprise Valley	37	4,000
Medicine Lake (Fourmile Hill)	36	170,000
Medicine Lake (Telephone Flat)	175	170,000
Niland	76	4,000
Randsburg	48	9,050
Salton Sea	1400	233,000
Sulphur Bank	43	4,000



# *MPR & Forecast LCOE*



Current Dollars (\$/kWh)				
Year	Wholesale Price CEC 2003 forecast	Wholesale Price E3-CPUC* Forecast	LCOE Combined Cycle*	Market Price Referent
2005	\$0.0316			\$0.0605
2006		\$0.0674	\$0.0693	\$0.0605
2010	\$0.0426	\$0.0630	\$0.0742	\$0.0605
2017	\$0.0587	\$0.0716	\$0.0915	\$0.0605



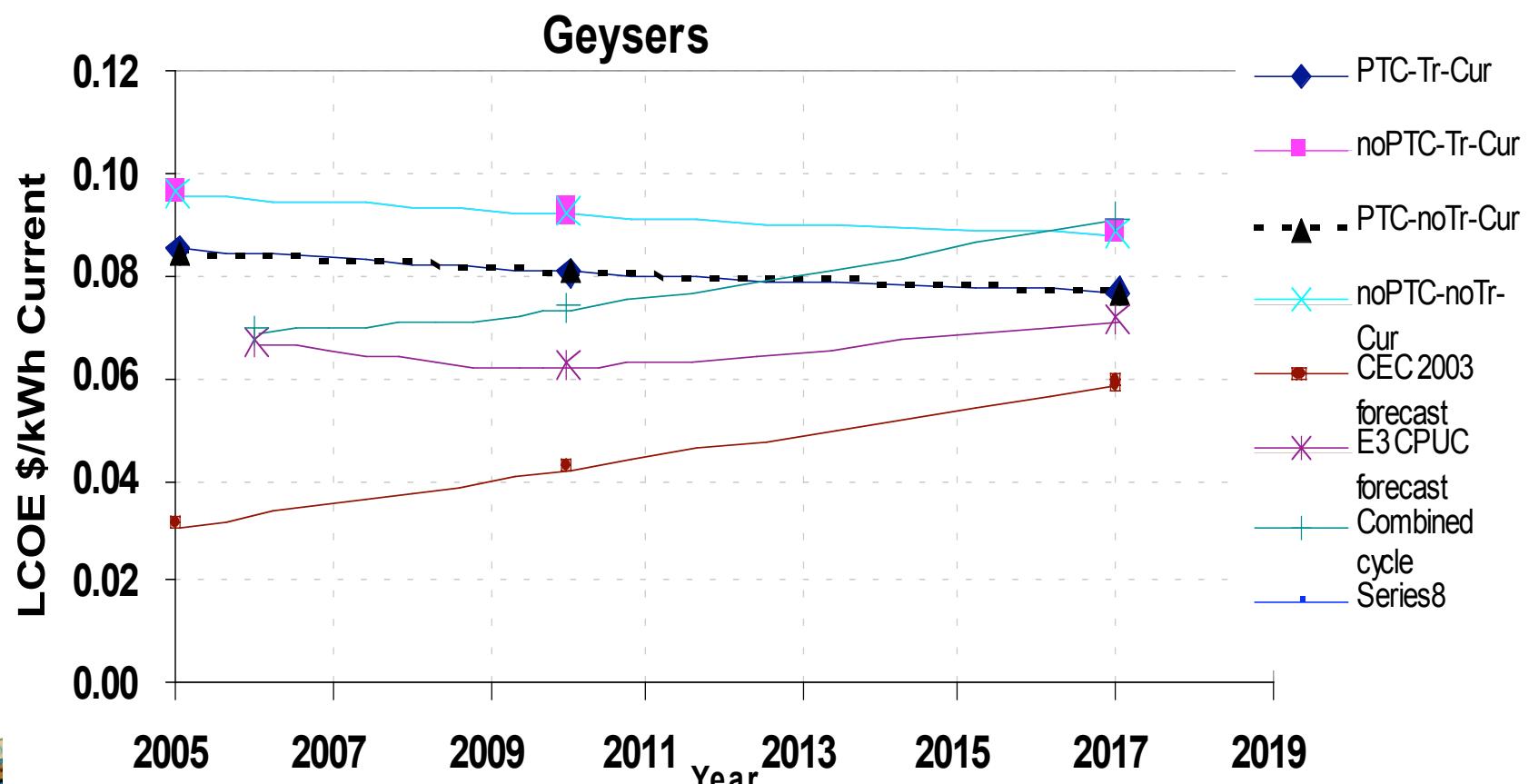
# *Dry Steam – LCOE (w/Transmission)*



Technology	Dry Steam							
	Ptl Dvlpt (MW)	Cap Cost	LCOE (\$/kWh) 2004 Current \$					
Year			2005	2005		2010		2017
Geothermal Resource Area		(\$/kW)	PTC	No PTC	PTC	No PTC	PTC	No PTC
Geysers	400	3,725	0.0856	0.0967	0.0816	0.0927	0.0776	0.0887



# *Dry Steam – with & without Transmission*

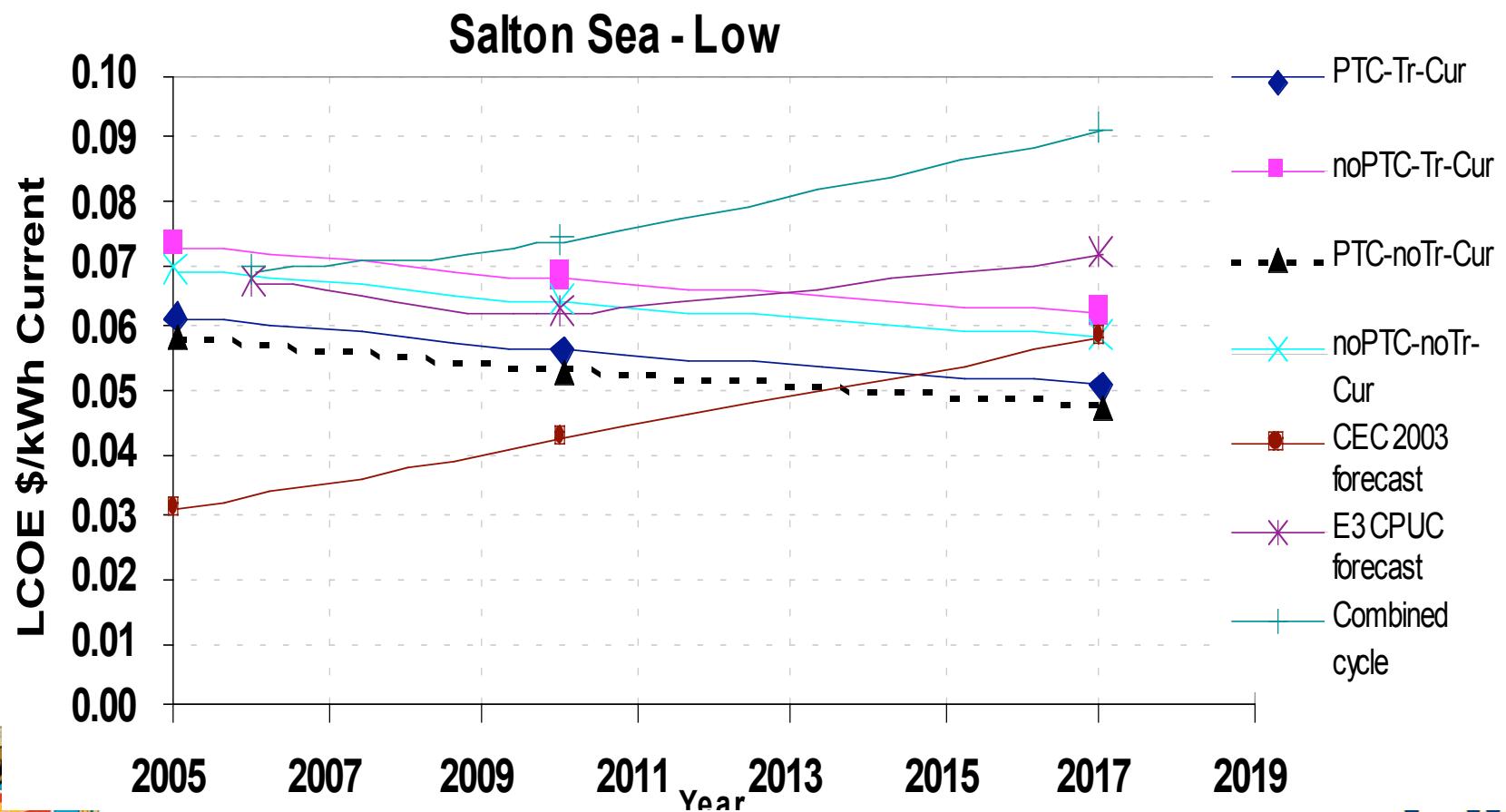


# *Dual Flash - LCOE (w/Transmission)*

Technology	Flash							
	Potnl Dvlpt (MW)	Cap Cost	LCOE (\$/kWh) 2004 Current \$					
Year			2005		2005		2010	
Geothermal Resource Area		(\$/kW)	PTC	No PTC	PTC	No PTC	PTC	No PTC
Calistoga	25	3,403	0.0869	0.0950	0.0819	0.0930	0.0760	0.0871
Brawley (North)	135	2,638	0.0766	0.0877	0.0708	0.0820	0.0644	0.0755
Brawley (East)	129	4,195	0.110	0.1221	0.1032	0.1143	0.0944	0.1055
Brawley (South)	62	4,606	0.1309	0.1420	0.1724	0.1335	0.1127	0.1239
Brawley (Total)	326	3,813	0.0989	0.1100	0.0917	0.1028	0.0835	0.0947
Coso	55	3,405	0.0852	0.0963	0.0785	0.0896	0.0711	0.0822
Lake City / Surprise Valley	37	3,146	0.0804	0.0915	0.0741	0.0852	0.0670	0.0782
Medicine Lake (Fourmile Hill)	36	2,674	0.1709	0.1820	0.1641	0.1752	0.1556	0.1667
Medicine Lake (Telephone Flat)	175	2,275	0.0802	0.0913	0.0749	0.0860	0.0688	0.0799
Niland	76	3,249	0.0814	0.0925	0.0250	0.0861	0.0678	0.0789
Randsburg	48	2,615	0.0706	0.087	0.0649	0.0760	0.0587	0.0698
Salton Sea (Low)	1400	2,250	0.0621	0.0732	0.0570	0.0681	0.0513	0.0624
Salton Sea (High)	1400	4,500	0.1112	0.1224	0.1031	0.1142	0.0940	0.1051
Sulphur Bank	43	2,347	0.0626	0.0737	0.0574	0.0685	0.0516	0.0627



# *Dual Flash – with & without Transmission*



# *Binary - LCOE (w/Transmission)*



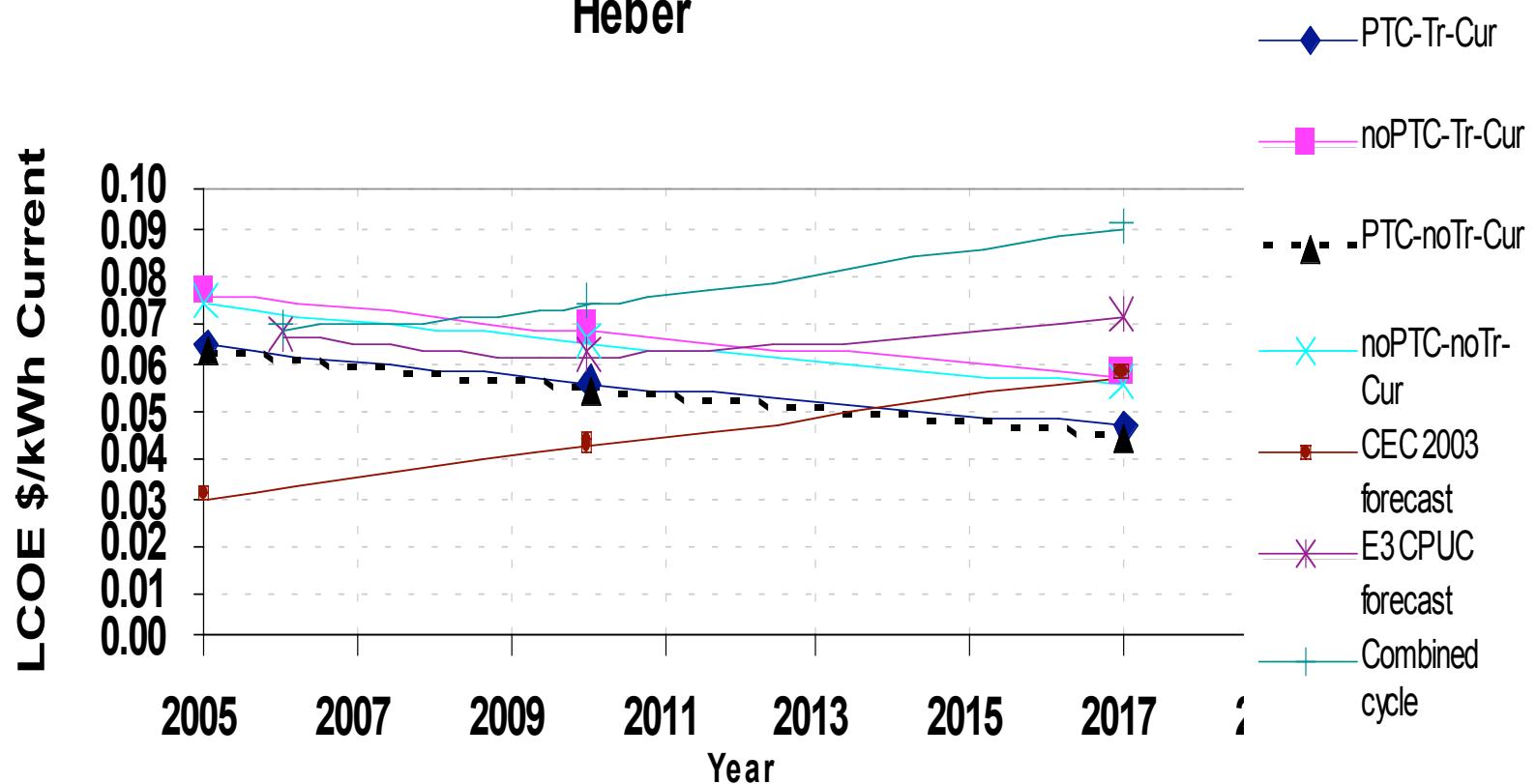
Technology	Binary							
	Potnl Dvlpt (MW)	Cap Cost	LCOE (\$/kWh) 2004 Current\$					
Year			2005	2005		2010		2017
Geothermal Resource Area		(\$/kW)	PTC	No PTC	PTC	No PTC	PTC	No PTC
Long Valley - M-P Leases	71	2,034	0.0594	0.0705	0.0540	0.0651	0.0496	0.0608
Honey Lake	1.9	2,684	0.1077	0.1188	0.0984	0.1095	0.0880	0.0991
Dunes	11	4,085	0.1005	0.1116	0.0888	0.0999	0.0744	0.0855
East Mesa	74.8	5,141	0.1162	0.1274	0.1022	0.1133	0.0847	0.0958
Glamis	6.4	4,953	0.1640	0.1751	0.1493	0.1604	0.1319	0.1430
Heber	42	2,706	0.0657	0.0768	0.0572	0.0684	0.0472	0.0583
Mount Signal	19	2,746	0.0734	0.0845	0.0647	0.0759	0.0545	0.0656
Sespe Hot Springs	5.3	4,112	0.1094	0.1205	0.0975	0.1086	0.0830	0.0941
Superstition Mountain	9.5	3,211	0.0785	0.0896	0.0689	0.0800	0.0573	0.0684



# *Binary – with & without Transmission*



Heber



# 2010 Current Costs/MPR



Known Geothermal Resource Area	County	Technical MW	2010 (Current \$)				MPR	
			Transmission		No Transmission			
			PTC	No PTC	PTC	No PTC		
Brawley (sum of Brawley, East Brawley, and South Brawley)	Imperial	326.0	\$ 0.0917	\$ 0.1028	\$ 0.0854	\$ 0.0965	\$ 0.0605	
Dunes	Imperial	11.0	\$ 0.0888	\$ 0.0999	\$ 0.0812	\$ 0.0924	\$ 0.0605	
East Mesa	Imperial	74.8	\$ 0.1022	\$ 0.1133	\$ 0.1011	\$ 0.1122	\$ 0.0605	
Glamis	Imperial	6.4	\$ 0.1493	\$ 0.1604	\$ 0.0976	\$ 0.1087	\$ 0.0605	
Heber	Imperial	42.0	\$ 0.0572	\$ 0.0684	\$ 0.0553	\$ 0.0664	\$ 0.0605	
Mount Signal	Imperial	19.0	\$ 0.0647	\$ 0.0759	\$ 0.0560	\$ 0.0671	\$ 0.0605	
Niland	Imperial	76.0	\$ 0.0750	\$ 0.0861	\$ 0.0738	\$ 0.0850	\$ 0.0605	
Salton Sea (including Westmoreland)	Imperial (low)	1400.0	\$ 0.0570	\$ 0.0681	\$ 0.0534	\$ 0.0645	\$ 0.0605	
	Imperial (high)		\$ 0.1031	\$ 0.1142	\$ 0.0995	\$ 0.1106	\$ 0.0605	
Superstition Mountain	Imperial	9.5	\$ 0.0689	\$ 0.0800	\$ 0.0648	\$ 0.0759	\$ 0.0605	
Coso Hot Springs	Inyo	55.0	\$ 0.0785	\$ 0.0896	\$ 0.0770	\$ 0.0881	\$ 0.0605	
Sulfur Bank Field, Clear Lake Area	Lake	43.0	\$ 0.0574	\$ 0.0685	\$ 0.0554	\$ 0.0665	\$ 0.0605	
Geysers [Lake and Sonoma]	Lake & Sonoma	400.0	\$ 0.0816	\$ 0.0927	\$ 0.0814	\$ 0.0925	\$ 0.0605	
Honey Lake (Wendel-Amedee)	Lassen	2.0	\$ 0.0984	\$ 0.1095	\$ 0.0549	\$ 0.0660	\$ 0.0605	
Lake City/ Surprise Valley	Modoc	37.0	\$ 0.0741	\$ 0.0852	\$ 0.0717	\$ 0.0828	\$ 0.0605	
Long Valley (mono- Long Valley) Mammoth Pacific Plants	Mono	71.0	\$ 0.0540	\$ 0.0651	\$ 0.0443	\$ 0.0554	\$ 0.0605	
Calistoga	Napa	25.0	\$ 0.0819	\$ 0.0930	\$ 0.0786	\$ 0.0897	\$ 0.0605	
Randsburg	San Bernardino/ Kern	48.0	\$ 0.0649	\$ 0.0760	\$ 0.0608	\$ 0.0720	\$ 0.0605	
Medicine Lake (Fieldwide including Fourmile Hill and Telephone Flat)	Siskiyou (Fourmile Hill)	36.0	\$ 0.1641	\$ 0.1752	\$ 0.0621	\$ 0.0732	\$ 0.0605	
	(Telephone Flat)	175.0	\$ 0.0749	\$ 0.0860	\$ 0.0539	\$ 0.0650	\$ 0.0605	
Sespe Hot Springs	Ventura	5.3	\$ 0.0975	\$ 0.1086	\$ 0.0818	\$ 0.0929	\$ 0.0605	



# 2010 Current Costs/CEC Wholesale



Known Geothermal Resource Area	County	Technica l MW	2010 (Current \$)				Wholesale	
			Transmission		No Transmission			
			PTC	No PTC	PTC	No PTC		
Brawley (sum of Brawley, East Brawley, and South Brawley)	Imperial	326.0	\$ 0.0742	\$ 0.0832	\$ 0.0691	\$ 0.0781	\$ 0.0426	
Dunes	Imperial	11.0	\$ 0.0718	\$ 0.0808	\$ 0.0657	\$ 0.0747	\$ 0.0426	
East Mesa	Imperial	74.8	\$ 0.0827	\$ 0.0917	\$ 0.0818	\$ 0.0908	\$ 0.0426	
Glamis	Imperial	6.4	\$ 0.1208	\$ 0.1298	\$ 0.0790	\$ 0.0879	\$ 0.0426	
Heber	Imperial	42.0	\$ 0.0463	\$ 0.0553	\$ 0.0447	\$ 0.0537	\$ 0.0426	
Mount Signal	Imperial	19.0	\$ 0.0524	\$ 0.0614	\$ 0.0453	\$ 0.0543	\$ 0.0426	
Niland	Imperial	76.0	\$ 0.0789	\$ 0.0879	\$ 0.0661	\$ 0.0751	\$ 0.0426	
Salton Sea (including Westmoreland)	Imperial (low) Imperial (high)	1400.0	\$ 0.0461 \$ 0.0834	\$ 0.0551 \$ 0.0924	\$ 0.0432 \$ 0.0805	\$ 0.0522 \$ 0.0895	\$ 0.0426	
Superstition Mountain	Imperial	9.5	\$ 0.0557	\$ 0.0647	\$ 0.0524	\$ 0.0614	\$ 0.0426	
Coso Hot Springs	Inyo	55.0	\$ 0.0635	\$ 0.0725	\$ 0.0623	\$ 0.0713	\$ 0.0426	
Sulfur Bank Field, Clear Lake Area	Lake	43.0	\$ 0.0464	\$ 0.0554	\$ 0.0448	\$ 0.0538	\$ 0.0426	
Geysers [Lake and Sonoma]	Lake & Sonoma	400.0	\$ 0.0660	\$ 0.0750	\$ 0.0658	\$ 0.0748	\$ 0.0426	
Honey Lake (Wendel-Amedee)	Lassen	2.0	\$ 0.0796	\$ 0.0886	\$ 0.0444	\$ 0.0534	\$ 0.0426	
Lake City/ Surprise Valley	Modoc	37.0	\$ 0.0599	\$ 0.0689	\$ 0.0580	\$ 0.0670	\$ 0.0426	
Long Valley (mono- Long Valley) Mammoth Pacific Plants	Mono	71.0	\$ 0.0437	\$ 0.0527	\$ 0.0358	\$ 0.0448	\$ 0.0426	
Calistoga	Napa	25.0	\$ 0.0662	\$ 0.0752	\$ 0.0636	\$ 0.0726	\$ 0.0426	
Randsburg	San Bernardino/ Kern	48.0	\$ 0.0525	\$ 0.0615	\$ 0.0492	\$ 0.0582	\$ 0.0426	
Medicine Lake (Fieldwide including Fourmile Hill and Telephone Flat)	(Fourmile Hill) (Telephone Flat)	36.0 175.0	\$ 0.1328 \$ 0.0606	\$ 0.1418 \$ 0.0696	\$ 0.0502 \$ 0.0436	\$ 0.0592 \$ 0.0526	\$ 0.0426	
Sespe Hot Springs	Ventura	5.3	\$ 0.0789	\$ 0.0879	\$ 0.0661	\$ 0.0751		



# 2010 Current Costs/CPUC-E<sup>3</sup>



Known Geothermal Resource Area	County	Technica l MW	2010 (Current \$)				E3-CPUC	
			Transmission		No Transmission			
			PTC	No PTC	PTC	No PTC		
Brawley (sum of Brawley, East Brawley, and South Brawley)	Imperial	326.0	\$ 0.0917	\$ 0.1028	\$ 0.0854	\$ 0.0965	\$0.0630	
Dunes	Imperial	11.0	\$ 0.0888	\$ 0.0999	\$ 0.0812	\$ 0.0924	\$0.0630	
East Mesa	Imperial	74.8	\$ 0.1022	\$ 0.1133	\$ 0.1011	\$ 0.1122	\$0.0630	
Glamis	Imperial	6.4	\$ 0.1493	\$ 0.1604	\$ 0.0976	\$ 0.1087	\$0.0630	
Heber	Imperial	42.0	\$ 0.0572	\$ 0.0684	\$ 0.0553	\$ 0.0664	\$0.0630	
Mount Signal	Imperial	19.0	\$ 0.0647	\$ 0.0759	\$ 0.0560	\$ 0.0671	\$0.0630	
Niland	Imperial	76.0	\$ 0.0750	\$ 0.0861	\$ 0.0738	\$ 0.0850	\$0.0630	
Salton Sea (including Westmoreland)	Imperial (low) Imperial (high)	1400.0	\$ 0.0570 \$ 0.1031	\$ 0.0681 \$ 0.1142	\$ 0.0534 \$ 0.0995	\$ 0.0645 \$ 0.1106	\$0.0630	
Superstition Mountain	Imperial	9.5	\$ 0.0689	\$ 0.0800	\$ 0.0648	\$ 0.0759	\$0.0630	
Coso Hot Springs	Inyo	55.0	\$ 0.0785	\$ 0.0896	\$ 0.0770	\$ 0.0881	\$0.0630	
Sulfur Bank Field, Clear Lake Area	Lake	43.0	\$ 0.0574	\$ 0.0685	\$ 0.0554	\$ 0.0665	\$0.0630	
Geysers [Lake and Sonoma]	Lake & Sonoma	400.0	\$ 0.0816	\$ 0.0927	\$ 0.0814	\$ 0.0925	\$0.0630	
Honey Lake (Wendel-Amedee)	Lassen	2.0	\$ 0.0984	\$ 0.1095	\$ 0.0549	\$ 0.0660	\$0.0630	
Lake City/ Surprise Valley	Modoc	37.0	\$ 0.0741	\$ 0.0852	\$ 0.0717	\$ 0.0828	\$0.0630	
Long Valley (mono- Long Valley) Mammoth Pacific Plants	Mono	71.0	\$ 0.0540	\$ 0.0651	\$ 0.0443	\$ 0.0554	\$0.0630	
Calistoga	Napa	25.0	\$ 0.0819	\$ 0.0930	\$ 0.0786	\$ 0.0897	\$0.0630	
Randsburg	San Bernardino/ Kern	48.0	\$ 0.0649	\$ 0.0760	\$ 0.0608	\$ 0.0720	\$0.0630	
Medicine Lake (Fieldwide including Fourmile Hill and Telephone Flat)	(Fourmile Hill) (Telephone Flat)	36.0 175.0	\$ 0.1641 \$ 0.0749	\$ 0.1752 \$ 0.0860	\$ 0.0621 \$ 0.0539	\$ 0.0732 \$ 0.0650	\$0.0630	
Sespe Hot Springs	Ventura	5.3	\$ 0.0975	\$ 0.1086	\$ 0.0818	\$ 0.0929	\$0.0630	



# 2010 Current Costs/Combined Cycle



Known Geothermal Resource Area	County	Technica l MW	2010 (Current \$)				Combined	
			Transmission		No Transmission			
			PTC	No PTC	PTC	No PTC		
Brawley (sum of Brawley, East Brawley, and South Brawley)	Imperial	326.0	\$ 0.0742	\$ 0.0832	\$ 0.0691	\$ 0.0781	\$ 0.0742	
Dunes	Imperial	11.0	\$ 0.0718	\$ 0.0808	\$ 0.0657	\$ 0.0747	\$ 0.0742	
East Mesa	Imperial	74.8	\$ 0.0827	\$ 0.0917	\$ 0.0818	\$ 0.0908	\$ 0.0742	
Glamis	Imperial	6.4	\$ 0.1208	\$ 0.1298	\$ 0.0790	\$ 0.0879	\$ 0.0742	
Heber	Imperial	42.0	\$ 0.0463	\$ 0.0553	\$ 0.0447	\$ 0.0537	\$ 0.0742	
Mount Signal	Imperial	19.0	\$ 0.0524	\$ 0.0614	\$ 0.0453	\$ 0.0543	\$ 0.0742	
Niland	Imperial	76.0	\$ 0.0789	\$ 0.0879	\$ 0.0661	\$ 0.0751	\$ 0.0742	
Salton Sea (including Westmoreland)	Imperial (low)	1400.0	\$ 0.0461	\$ 0.0551	\$ 0.0432	\$ 0.0522	\$ 0.0742	
	Imperial (high)		\$ 0.0834	\$ 0.0924	\$ 0.0805	\$ 0.0895	\$ 0.0742	
Superstition Mountain	Imperial	9.5	\$ 0.0557	\$ 0.0647	\$ 0.0524	\$ 0.0614	\$ 0.0742	
Coso Hot Springs	Inyo	55.0	\$ 0.0635	\$ 0.0725	\$ 0.0623	\$ 0.0713	\$ 0.0742	
Sulfur Bank Field, Clear Lake Area	Lake	43.0	\$ 0.0464	\$ 0.0554	\$ 0.0448	\$ 0.0538	\$ 0.0742	
Geysers [Lake and Sonoma]	Lake & Sonoma	400.0	\$ 0.0660	\$ 0.0750	\$ 0.0658	\$ 0.0748	\$ 0.0742	
Honey Lake (Wendel-Amedee)	Lassen	2.0	\$ 0.0796	\$ 0.0886	\$ 0.0444	\$ 0.0534	\$ 0.0742	
Lake City/ Surprise Valley	Modoc	37.0	\$ 0.0599	\$ 0.0689	\$ 0.0580	\$ 0.0670	\$ 0.0742	
Long Valley (mono- Long Valley) Mammoth Pacific Plants	Mono	71.0	\$ 0.0437		\$ 0.0527		\$ 0.0742	
			\$ 0.0662		\$ 0.0752			
Calistoga	Napa	25.0	\$ 0.0525		\$ 0.0615		\$ 0.0742	
			\$ 0.0636		\$ 0.0726			
Randsburg		48.0	\$ 0.0492		\$ 0.0582		\$ 0.0742	
			\$ 0.0525		\$ 0.0615			
Medicine Lake (Fieldwide including Fourmile Hill and Telephone Flat)	(Fourmile Hill)	36.0	\$ 0.1328		\$ 0.1418		\$ 0.0742	
			\$ 0.0606		\$ 0.0696			
Sespe Hot Springs	Ventura	5.3	\$ 0.0789	\$ 0.0879	\$ 0.0661	\$ 0.0751	\$ 0.0742	



# 2017 Current Costs/MPR



Known Geothermal Resource Area	County	Technica l MW	2017 (Current \$)				
			Transmission		No Transmission		
			PTC	No PTC	PTC	No PTC	MPR
Brawley (sum of Brawley, East Brawley, and South Brawley)	Imperial	326.0	\$ 0.0835	\$ 0.0947	\$ 0.0774	\$ 0.0885	\$0.0605
Dunes	Imperial	11.0	\$ 0.0744	\$ 0.0855	\$ 0.0670	\$ 0.0781	\$0.0605
East Mesa	Imperial	74.8	\$ 0.0847	\$ 0.0958	\$ 0.0836	\$ 0.0947	\$0.0605
Glamis	Imperial	6.4	\$ 0.1319	\$ 0.1430	\$ 0.0807	\$ 0.0918	\$0.0605
Heber	Imperial	42.0	\$ 0.0472	\$ 0.0583	\$ 0.0453	\$ 0.0564	\$0.0605
Mount Signal	Imperial	19.0	\$ 0.0830	\$ 0.0941	\$ 0.0674	\$ 0.0785	\$0.0605
Niland	Imperial	76.0	\$ 0.0678	\$ 0.0789	\$ 0.0667	\$ 0.0778	\$0.0605
Salton Sea (including Westmoreland)	Imperial (low)	1400.0	\$ 0.0513	\$ 0.0624	\$ 0.0478	\$ 0.0589	\$0.0605
	Imperial (high)		\$ 0.0940	\$ 0.1051	\$ 0.0904	\$ 0.1016	\$0.0605
Superstition Mountain	Imperial	9.5	\$ 0.0573	\$ 0.0684	\$ 0.0532	\$ 0.0643	\$0.0605
Coso Hot Springs	Inyo	55.0	\$ 0.0711	\$ 0.0822	\$ 0.0697	\$ 0.0808	\$0.0605
Sulfur Bank Field, Clear Lake Area	Lake	43.0	\$ 0.0516	\$ 0.0627	\$ 0.0496	\$ 0.0607	\$0.0605
Geysers [Lake and Sonoma]	Lake & Sonoma	400.0	\$ 0.0776	\$ 0.0887	\$ 0.0774	\$ 0.0885	\$0.0605
Honey Lake (Wendel-Amedee)	Lassen	2.0	\$ 0.0880	\$ 0.0991	\$ 0.0449	\$ 0.0560	\$0.0605
Lake City/ Surprise Valley	Modoc	37.0	\$ 0.0670	\$ 0.0782	\$ 0.0648	\$ 0.0759	\$0.0605
Long Valley (mono- Long Valley) Mammoth Pacific Plants	Mono	71.0	\$ 0.0496	\$ 0.0608	\$ 0.0400	\$ 0.0511	\$0.0605
	Napa	25.0	\$ 0.0760	\$ 0.0871	\$ 0.0728	\$ 0.0839	\$0.0605
Randsburg	San Bernardino/ Kern	48.0	\$ 0.0587	\$ 0.0698	\$ 0.0547	\$ 0.0658	\$0.0605
Medicine Lake (Fieldwide including Fourmile Hill and Telephone Flat)	Siskiyou	304.0					
	(Fourmile Hill)	36.0	\$ 0.1556	\$ 0.1667	\$ 0.0558	\$ 0.0669	\$0.0605
Sespe Hot Springs	(Telephone Flat)	175.0	\$ 0.0688	\$ 0.0799	\$ 0.0482	\$ 0.0593	\$0.0605
	Ventura	5.3	\$ 0.0830	\$ 0.0941	\$ 0.0674	\$ 0.0785	\$0.0605



# 2017 Current Costs/CEC Wholesale



Known Geothermal Resource Area	County	Technica l MW	2017 (Current \$)				Wholesale	
			Transmission		No Transmission			
			PTC	No PTC	PTC	No PTC		
Brawley (sum of Brawley, East Brawley, and South Brawley	Imperial	326.0	\$ 0.0676	\$ 0.0766	\$ 0.0626	\$ 0.0716	\$ 0.0587	
Dunes	Imperial	11.0	\$ 0.0602	\$ 0.0692	\$ 0.0542	\$ 0.0632	\$ 0.0587	
East Mesa	Imperial	74.8	\$ 0.0686	\$ 0.0775	\$ 0.0677	\$ 0.0767	\$ 0.0587	
Glamis	Imperial	6.4	\$ 0.1067	\$ 0.1157	\$ 0.0653	\$ 0.0743	\$ 0.0587	
Heber	Imperial	42.0	\$ 0.0382	\$ 0.0472	\$ 0.0366	\$ 0.0456	\$ 0.0587	
Mount Signal	Imperial	19.0	\$ 0.0441	\$ 0.0531	\$ 0.0371	\$ 0.0461	\$ 0.0587	
Niland	Imperial	76.0	\$ 0.0607	\$ 0.0697	\$ 0.0598	\$ 0.0687	\$ 0.0587	
Salton Sea (including Westmoreland)	Imperial (low)	1400.0	\$ 0.0461	\$ 0.0551	\$ 0.0432	\$ 0.0522	\$ 0.0587	
	Imperial (high)		\$ 0.0834	\$ 0.0924	\$ 0.0805	\$ 0.0895	\$ 0.0587	
Superstition Mountain	Imperial	9.5	\$ 0.0463	\$ 0.0553	\$ 0.0431	\$ 0.0521	\$ 0.0587	
Coso Hot Springs	Inyo	55.0	\$ 0.0575	\$ 0.0665	\$ 0.0564	\$ 0.0654	\$ 0.0587	
Sulfur Bank Field, Clear Lake Area	Lake	43.0	\$ 0.0417	\$ 0.0507	\$ 0.0401	\$ 0.0491	\$ 0.0587	
Geysers [Lake and Sonoma]	Lake & Sonoma	400.0	\$ 0.0628	\$ 0.0717	\$ 0.0626	\$ 0.0716	\$ 0.0587	
Honey Lake (Wendel-Amedee)	Lassen	2.0	\$ 0.0712	\$ 0.0802	\$ 0.0363	\$ 0.0453	\$ 0.0587	
Lake City/ Surprise Valley	Modoc	37.0	\$ 0.0542	\$ 0.0632	\$ 0.0524	\$ 0.0614	\$ 0.0587	
Long Valley (mono- Long Valley) Mammoth Pacific Plants	Mono	71.0	\$ 0.0402	\$ 0.0492	\$ 0.0324	\$ 0.0414	\$ 0.0587	
Calistoga	Napa	25.0	\$ 0.0615	\$ 0.0705	\$ 0.0589	\$ 0.0679	\$ 0.0587	
Randsburg	San Bernardino/ Kern	48.0	\$ 0.0475	\$ 0.0565	\$ 0.0442	\$ 0.0532	\$ 0.0587	
	Siskiyou	304.0						
Medicine Lake (Fieldwide including Fourmile Hill and Telephone Flat)	(Fourmile Hill)	36.0	\$ 0.1259	\$ 0.1349	\$ 0.0452	\$ 0.0541	\$ 0.0587	
	(Telephone Flat)	175.0	\$ 0.0556	\$ 0.0646	\$ 0.0390	\$ 0.0480	\$ 0.0587	
Sespe Hot Springs	Ventura	5.3	\$ 0.0671	\$ 0.0761	\$ 0.0545	\$ 0.0635		



# 2017 Current Costs/CPUC-E<sup>3</sup>



Known Geothermal Resource Area	County	Technica l MW	2017 (Current \$)				E3-CPUC	
			Transmission		No Transmission			
			PTC	No PTC	PTC	No PTC		
Brawley (sum of Brawley, East Brawley, and South Brawley)	Imperial	326.0	\$ 0.0835	\$ 0.0947	\$ 0.0774	\$ 0.0885	\$ 0.0716	
Dunes	Imperial	11.0	\$ 0.0744	\$ 0.0855	\$ 0.0670	\$ 0.0781	\$ 0.0716	
East Mesa	Imperial	74.8	\$ 0.0847	\$ 0.0958	\$ 0.0836	\$ 0.0947	\$ 0.0716	
Glamis	Imperial	6.4	\$ 0.1319	\$ 0.1430	\$ 0.0807	\$ 0.0918	\$ 0.0716	
Heber	Imperial	42.0	\$ 0.0472	\$ 0.0583	\$ 0.0453	\$ 0.0564	\$ 0.0716	
Mount Signal	Imperial	19.0	\$ 0.0830	\$ 0.0941	\$ 0.0674	\$ 0.0785	\$ 0.0716	
Niland	Imperial	76.0	\$ 0.0678	\$ 0.0789	\$ 0.0667	\$ 0.0778	\$ 0.0716	
Salton Sea (including Westmoreland)	Imperial (low) Imperial (high)	1400.0	\$ 0.0513 \$ 0.0940	\$ 0.0624 \$ 0.1051	\$ 0.0478 \$ 0.0904	\$ 0.0589 \$ 0.1016	\$ 0.0716	
Superstition Mountain	Imperial	9.5	\$ 0.0573	\$ 0.0684	\$ 0.0532	\$ 0.0643	\$ 0.0716	
Coso Hot Springs	Inyo	55.0	\$ 0.0711	\$ 0.0822	\$ 0.0697	\$ 0.0808	\$ 0.0716	
Sulfur Bank Field, Clear Lake Area	Lake	43.0	\$ 0.0516	\$ 0.0627	\$ 0.0496	\$ 0.0607	\$ 0.0716	
Geysers [Lake and Sonoma]	Lake & Sonoma	400.0	\$ 0.0776	\$ 0.0887	\$ 0.0774	\$ 0.0885	\$ 0.0716	
Honey Lake (Wendel-Amedee)	Lassen	2.0	\$ 0.0880	\$ 0.0991	\$ 0.0449	\$ 0.0560	\$ 0.0716	
Lake City/ Surprise Valley	Modoc	37.0	\$ 0.0670	\$ 0.0782	\$ 0.0648	\$ 0.0759	\$ 0.0716	
Long Valley (mono- Long Valley) Mammoth Pacific Plants	Mono	71.0	\$ 0.0496	\$ 0.0608	\$ 0.0400	\$ 0.0511	\$ 0.0716	
Calistoga	Napa	25.0	\$ 0.0760	\$ 0.0871	\$ 0.0728	\$ 0.0839	\$ 0.0716	
Randsburg	San Bernardino/ Kern	48.0	\$ 0.0587	\$ 0.0698	\$ 0.0547	\$ 0.0658	\$ 0.0716	
Medicine Lake (Fieldwide including Fourmile Hill and Telephone Flat)	Siskiyou (Fourmile Hill) (Telephone Flat)	304.0 36.0 175.0	\$ 0.1556 \$ 0.0688 \$ 0.0688	\$ 0.1667 \$ 0.0799 \$ 0.0799	\$ 0.0558 \$ 0.0482 \$ 0.0482	\$ 0.0669 \$ 0.0593 \$ 0.0593	\$ 0.0716 \$ 0.0716 \$ 0.0716	
Sespe Hot Springs	Ventura	5.3	\$ 0.0830	\$ 0.0941	\$ 0.0674	\$ 0.0785	\$ 0.0716	



# 2017 Current Costs/Combined Cycle



Known Geothermal Resource Area	County	Technica l MW	2017 (Current \$)						
			Transmission		No Transmission				
			PTC	No PTC	PTC	No PTC	Combined		
Brawley (sum of Brawley, East Brawley, and South Brawley)	Imperial	326.0	\$ 0.0676	\$ 0.0766	\$ 0.0626	\$ 0.0716	\$ 0.0915		
Dunes	Imperial	11.0	\$ 0.0602	\$ 0.0692	\$ 0.0542	\$ 0.0632	\$ 0.0915		
East Mesa	Imperial	74.8	\$ 0.0686	\$ 0.0775	\$ 0.0677	\$ 0.0767	\$ 0.0915		
Glamis	Imperial	6.4	\$ 0.1067	\$ 0.1157	\$ 0.0653	\$ 0.0743	\$ 0.0915		
Heber	Imperial	42.0	\$ 0.0382	\$ 0.0472	\$ 0.0366	\$ 0.0456	\$ 0.0915		
Mount Signal	Imperial	19.0	\$ 0.0441	\$ 0.0531	\$ 0.0371	\$ 0.0461	\$ 0.0915		
Niland	Imperial	76.0	\$ 0.0607	\$ 0.0697	\$ 0.0598	\$ 0.0687	\$ 0.0915		
Salton Sea (including Westmoreland)	Imperial (low) Imperial (high)	1400.0	\$ 0.0461 \$ 0.0834	\$ 0.0551 \$ 0.0924	\$ 0.0432 \$ 0.0805	\$ 0.0522 \$ 0.0895	\$ 0.0915 \$ 0.0915		
Superstition Mountain	Imperial	9.5	\$ 0.0463	\$ 0.0553	\$ 0.0431	\$ 0.0521	\$ 0.0915		
Coso Hot Springs	Inyo	55.0	\$ 0.0575	\$ 0.0665	\$ 0.0564	\$ 0.0654	\$ 0.0915		
Sulfur Bank Field, Clear Lake Area	Lake	43.0	\$ 0.0417	\$ 0.0507	\$ 0.0401	\$ 0.0491	\$ 0.0915		
Geysers [Lake and Sonoma]	Lake & Sonoma	400.0	\$ 0.0628	\$ 0.0717	\$ 0.0626	\$ 0.0716	\$ 0.0915		
Honey Lake (Wendel-Amedee)	Lassen	2.0	\$ 0.0712	\$ 0.0802	\$ 0.0363	\$ 0.0453	\$ 0.0915		
Lake City/ Surprise Valley	Modoc	37.0	\$ 0.0542	\$ 0.0632	\$ 0.0524	\$ 0.0614	\$ 0.0915		
Long Valley (mono- Long Valley) Mammoth Pacific Plants	Mono	71.0	\$ 0.0402	\$ 0.0492	\$ 0.0324	\$ 0.0414	\$ 0.0915		
Calistoga	Napa	25.0	\$ 0.0615	\$ 0.0705	\$ 0.0589	\$ 0.0679	\$ 0.0915		
Randsburg	San Bernardino/ Kern	48.0	\$ 0.0475	\$ 0.0565	\$ 0.0442	\$ 0.0532	\$ 0.0915		
Medicine Lake (Fieldwide including Fourmile Hill and Telephone Flat)	(Fourmile Hill) (Telephone Flat)	36.0 175.0	\$ 0.1259 \$ 0.0556	\$ 0.1349 \$ 0.0646	\$ 0.0452 \$ 0.0390	\$ 0.0541 \$ 0.0480	\$ 0.0915 \$ 0.0915		
Sespe Hot Springs	Ventura	5.3	\$ 0.0671	\$ 0.0761	\$ 0.0545	\$ 0.0635	\$ 0.0915		



# *Contact Information*



*Elaine Sison-Lebrilla*

**(916) 653-0363**

[esisonle@energy.state.ca.us](mailto:esisonle@energy.state.ca.us)

